

CLAIMS

[0061] The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of providing an extended range of absolute pressure measurements of a gas in a chamber, comprising:

measuring differential pressure between the gas in the chamber and the atmosphere to provide a measured differential pressure;

measuring absolute pressure of the gas in the chamber to provide a measured absolute chamber pressure;

establishing a cross-over pressure level;

determining the absolute pressure in the chamber to be equivalent to the measured absolute chamber pressure, when the measured absolute chamber pressure is less than the cross-over pressure level;

determining the absolute pressure in the chamber to be equivalent to a normalized differential pressure, when the measured absolute pressure is greater than the cross-over pressure level, including determining the normalized differential pressure by adding a correlation factor to the measured differential chamber pressure, wherein the correlation factor is equal to the measured absolute chamber pressure minus the measured differential chamber pressure.

2. The method of claim 1, including determining the correlation factor when the absolute pressure is below a correlation pressure threshold.

3. The method of claim 1, including establishing the correlation pressure threshold somewhere in a pressure range wherein instruments used to measure the differential pressure and

the absolute pressure provide the measured differential chamber pressure and the measured absolute chamber pressure with as much accuracy and reliability as is needed for the extended range of absolute pressure measurements.

4. The method of claim 1, including measuring the differential pressure between the gas in the chamber and the atmosphere with a differential pressure sensor.

5. The method of claim 4, wherein the differential pressure sensor includes a diaphragm-type pressure sensor.

6. The method of claim 5, wherein the differential pressure sensor includes a piezo differential pressure sensor.

7. The method of claim 5, wherein the differential pressure sensor includes a capacitive manometer differential pressure sensor.

8. The method of claim 4, wherein the differential pressure sensor includes a thermal couple differential pressure sensor.

9. The method of claim 1, including measuring the absolute pressure of the gas in the chamber with an absolute pressure sensor.

10. The method of claim 9, wherein the absolute pressure sensor includes a thermal conductivity type pressure sensor.

11. The method of claim 10, wherein the absolute pressure sensor includes a pirani-type pressure sensor.

12. The method of claim 9, wherein the absolute pressure sensor includes a capacitance manometer pressure sensor.

13. A method of providing an absolute chamber pressure profile of gas pressure in a chamber as the pressure in the chamber changes over time, comprising:

measuring absolute pressure in the chamber with an absolute pressure sensor that has an accurate and dependable range of absolute pressure measuring capability;

measuring differential pressure between the chamber and atmospheric pressure with a differential pressure sensor that has an accurate and dependable range of differential pressure measuring capability, which corresponds with at least a portion of the accurate and dependable range of the absolute pressure sensor;

determining a correlation factor between an absolute pressure measurement from the absolute pressure sensor that is considered to be accurate and reliable and a differential pressure measurement from the differential pressure sensor taken at the same time as the absolute pressure measurement;

using the absolute pressure measurements from the absolute pressure sensor for the absolute chamber pressure profile in pressure ranges where the absolute pressure measurements from the absolute pressure sensors are more accurate and reliable than the differential pressure measurements from the differential pressure sensor; and

using the differential pressure measurements from the differential pressure sensor, adjusted by the correlation factor to provide virtual absolute pressure measurements, for the absolute chamber pressure profile where the differential pressure measurements from the differential pressure sensor are more accurate and reliable than the absolute pressure measurements from the absolute pressure sensor.

14. The method of claim 13, including determining the correlation factor by subtracting a differential pressure measurement from an absolute pressure measurement, which is taken at the same time as the differential pressure measurement.

15. The method of claim 14, including subtracting a differential pressure measurement from an absolute pressure measurement taken at a time when the absolute chamber pressure is low enough to be at or below the bottom of the accurate and dependable range of differential pressure measuring capability.

16. The method of claim 14, including subtracting a differential pressure measurement from an absolute pressure measurement taken at a time when the chamber pressure is equal to the atmospheric pressure.

17. The method of claim 13, including measuring the absolute pressure in the chamber with an absolute pressure sensor that has an accurate and dependable range of absolute pressure measuring capability, which extends below the accurate and dependable range of the differential pressure measuring capability.

18. The method of claim 17, including:

selecting a cross-over pressure level in the portion of the accurate and dependable range of differential pressure measuring capability that corresponds with the portion of the accurate and dependable range of the absolute pressure sensor;

using the absolute pressure measurements from the absolute pressure sensor for the absolute chamber pressure profile when the absolute pressure measurements of the chamber pressure from the absolute pressure sensor are below the cross-over pressure level; and

using the virtual absolute pressure measurements for the absolute chamber pressure profile when the virtual absolute pressure measurements of the chamber pressure are above the cross-over pressure level.

19. The method of claim 18, wherein the cross-over pressure level is at a single pressure value.

20. The method of claim 18, wherein the cross-over pressure level comprises a cross-over pressure range and the method includes using blended absolute pressure values comprising weighted averages of both absolute pressure measurements and virtual absolute pressure measurements in said cross-over pressure range for the absolute chamber pressure profile.

21. The method of claim 15, wherein the bottom of the accurate and dependable range of differential pressure measuring capability is a correlation pressure threshold, and wherein the method includes cycling the chamber pressure up and down in such a manner that the absolute pressure measurements from the absolute pressure sensor repeatedly drop below the correlation pressure threshold and determining the correlation factor again each time that the absolute pressure measurements drop below the correlation pressure threshold to adjust the correlation factor for any changes in atmospheric pressure that occur during such cycling.

22. The method of claim 17, wherein said absolute pressure sensor is a first absolute pressure sensor and the method includes:

measuring the absolute pressure in the chamber with a second absolute pressure sensor that has an accurate and dependable range of absolute pressure measuring capability, a first portion of which is coincident with a portion of the accurate and dependable range of the first absolute pressure sensor, and a second

portion of which extends to absolute pressures below the accurate and dependable range of the first absolute pressure sensor; and

using absolute pressure measurements from the second absolute pressure sensor for the absolute chamber pressure profile in pressure ranges where the absolute pressure measurements from the second absolute pressure sensor are more accurate and reliable than the absolute pressure measurements from the first absolute pressure sensor.

23. Apparatus for measuring absolute pressure in a chamber, i.e., chamber pressure, over time, comprising:

a differential pressure sensor for measuring differential pressure between atmospheric pressure and the chamber pressure;

an absolute pressure sensor for measuring the absolute pressure in the chamber;

means connected to the differential pressure sensor and to the absolute pressure sensor for determining a correlation factor between absolute pressure measurements from the absolute pressure sensor and differential pressure measurements from the differential pressure sensor;

means for adjusting differential pressure measurements from the differential pressure sensor with the correlation factor to produce virtual absolute pressure measurements; and

means for outputting the absolute pressure measurements from the absolute pressure sensor in chamber pressure ranges where the absolute pressure measurements from the absolute pressure sensor are more accurate and reliable

than the virtual absolute pressure measurements and for outputting the virtual absolute pressure measurements in chamber pressure ranges where the virtual pressure measurements are more accurate and reliable than the absolute pressure measurements from the absolute pressure sensor.